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1 SPECIFICATION

2
3 GREASE BATH SEAL FOR SWING MECHANISM
4 OF CONSTRUCTION MACHINE

5
6 BACKGROUND OF THE INVENTION

7 Field of the Art

8 This invention relates to a grease bath seal for use with a grease
9 bath of a swing mechanism of a construction machine, for example, a
10 swing mechanism on a hydraulic power shovel or excavator or a swing
11 mechanism on a hydraulic crane.

12 Technical Background

13 Generally speaking, construction machines like hydraulic power
14 shovels or excavators have an excavating or other working mechanism
15 mounted on an upper swing structure which is rotatably mounted on a
16 vehicular base carrier. Through a swing mechanism, the upper swing
17 structure is rotatably supported on the vehicular base carrier. The
18 swing mechanism is largely constituted by an outer ring which is
19 mounted on a swing frame of the upper swing structure, an inner ring

1 which is mounted on a top frame plate on the side of the vehicular
2 base carrier, and bearings interposed between the outer and inner
3 rings. A swinging pinion which is rotationally driven from a hydraulic
4 motor is meshed with a ring gear which is formed on and around the
5 inner periphery of the inner ring. A grease bath in the form of an
6 annular groove is provided on the side of the vehicular base carrier for
7 pooling grease to be used as a lubricant for meshed sliding portions of
8 the ring gear and the swinging pinion. On the inner peripheral side,
9 the annular groove of the grease bath is bounded by a tubular wall.
10 Upper end portions of this tubular wall have to be kept out of contact
11 with the swing frame of the upper swing structure. Therefore, the
12 upper end of the tubular wall in the inner side of the grease bath is
13 usually left in an open state despite intrusion of water, mud, dirt or
14 other pollutants through upper open portions. Intrusion of such
15 pollutants accelerate deteriorations of grease to invite low lubricity of
16 meshed portions of the ring gear and swinging pinion, resulting in
17 development of rust in a worse case.

18 In solving the problem just mentioned, it has been known in the
19 art to provide a seal member on a tubular wall at the inner periphery

1 of a grease bath for the purpose of preventing intrusion of pollutants
2 into the grease bath, as described in Japanese Laid-Open Utility Model
3 Application S64-5961. This prior art seal member is arranged to be
4 gripped on the tubular wall in a fixed state, with its fore end portion
5 held in sliding contact with a swing frame.

6 In this connection, from the standpoint of economical use of
7 grease, it is desirable that the grease bath has the minimum necessary
8 capacity in volume, that is to say, it is desirable that the grease bath
9 has a width slightly larger than the outside diameter of the swinging
10 pinion. For this purpose, it becomes necessary to mount a seal
11 member on a tubular wall of a larger diameter. As a result, the
12 circumferential speed in swinging motions of the upper swing
13 structure is increased to accelerate abrasive wear of the seal member.
14 Therefore, the seal member prematurely loses its sealing power. In
15 addition, when the upper swing structure and the vehicular base
16 carrier are moved in upward and downward directions, respectively,
17 under the influence of vibrations which are generated by a machine
18 operation, the seal member is set apart from the frame of the upper
19 swing structure, opening up a gap space which would permit intrusion

1 of pollutants into the grease bath. Furthermore, at the time of
2 replacing a seal member which no longer has a sufficient sealing
3 power, it has been necessitated to separate the upper swing structure
4 from the vehicular base carrier. That is to say, troublesome heavy jobs
5 have been required for replacement of a seal member.

6 DISCLOSURE OF THE INVENTION

7 In view of the foregoing situations, it is an object of the present
8 invention to provide a grease bath seal for a swing mechanism of a
9 construction machine, which can prevent intrusion of pollutants or
10 other foreign material into a grease bath over an extended period of
11 time in a reliable manner.

12 It is another object of the present invention to provide a grease
13 bath seal of the sort as mentioned above, which is arranged in such a
14 manner as to improve the durability and tightness of a seal member.

15 It is still another object of the present invention to provide a
16 grease bath seal of the sort as mentioned above, which can maintain a
17 function of lubricating meshed portions of a swinging pinion and a
18 ring gear over an extended period of time.

19 It is a further object of the present invention to provide a grease

1 bath of the sort as mentioned above, which is arranged particularly to
2 facilitate replacement of a seal member of the grease bath of the swing
3 mechanism.

4 In order to achieve the foregoing objectives, according to the
5 present invention, there is provided a grease bath seal for a swing
6 mechanism of a construction machine, having an inner ring on the
7 side of a vehicular base carrier of the machine relatively rotatably
8 coupled with an outer ring on a swing frame on the side of an upper
9 swing structure of the construction machine, a ring gear provided at
10 and around the inner periphery of the inner ring and meshed with a
11 swing pinion on the side of the upper swing structure, a center joint
12 located within an opening provided in the swing frame at a rotational
13 center thereof, and a grease bath located beneath the swing frame and
14 around the center joint and defining an annular grease bath portion
15 around a top plateau wall connected to the center joint, thereby to
16 lubricate meshed portions of the ring gear and the swing pinion,
17 characterized in that the grease bath seal comprises: an annular seal
18 member having a height larger than a width of a spacing between the
19 swing frame of the upper swing structure and the top plateau wall of

1 the grease bath in a free state and interposed in a compressed state
2 between the top plateau wall and the swing frame at a position radially
3 outward of the center joint; and the seal member being detachably
4 fixed either on the side of the swing frame or on the side of the top
5 plateau wall of the grease bath, and having an annular sliding portion
6 extended out in a radially inward direction from the other side for
7 pressed sliding contact with the top plateau wall or the swing frame.

8
9 The grease bath serves to pool a lubricant, typically grease.
10 However, a lubricant of any other kind can be stored in the grease
11 bath as long as it is suited for lubricating meshed portions of the
12 swinging pinion and the ring gear. The top plateau wall, which is
13 connected to the center joint, is extended radially inward from other
14 bath-forming walls. In this instance, the top plateau wall may be
15 formed integrally with bath-forming walls as one integral structure.
16 Any way, the top plateau wall is located almost entirely in face to face
17 relation with the swing frame of the upper swing structure.
18 Accordingly, a seal member can be located at any arbitrary radial
19 position between the swing frame and the top plateau wall of the

1 grease bath. However, it is desirable to locate the seal member in the
2 proximity of the center joint which is at the center of swing motions of
3 the upper swing structure.

4 The seal member is fixed on one of the top plateau wall of the
5 grease bath and the swing frame, and held in sliding contact with the
6 other one. The seal member may be formed in a square, rectangular
7 or circular shape in section, and anchored either on the side of the top
8 plateau wall or on the side of the swing frame, preferably on the upper
9 side of the top plateau wall of the grease bath. More specifically, in a
10 preferred form of the present invention, the seal member is constituted
11 by an annular main block having an anchoring end portion and a
12 lipped end portion on the outer and inner peripheral sides thereof. An
13 annular lip portion is erected at and along the inner periphery of the
14 lipped end portion. A sliding end portion is provided at the top of the
15 lip portion.

16 In order to detachably fix the seal member in a sealing position
17 on the grease bath, a seal holder in the form of a staggered ring is
18 fixed on the top plateau wall of the grease bath. The staggered ring
19 has a base portion and a holder portion on the outer and inner

1 peripheral sides thereof. The base portion is fixed on the top plateau
2 wall, and the holder portion is raised from the surface of the top
3 plateau wall to form an annular open seal socket on the inner
4 peripheral side. The anchoring end portion on the outer peripheral
5 side of the main block of the seal member is fixedly gripped in a
6 compressed state between the annular holder portion of the seal
7 holder and the top plateau wall. Therefore, when the seal member is
8 worn out, it can be easily removed and replaced by a fresh one since
9 the inner peripheral side of the top plateau wall is opened up in a
10 readily accessible state upon dismantling the center joint from an
11 opening at the center of the swing frame.

12 The annular lip portion of the seal member is projected upward
13 from the lipped end portion of the main block, preferably at the inner
14 periphery of the lipped end portion. Preferably, the lip portion is
15 inclined radially inward so that its fore end portion is bent inward
16 toward the center of swing motion through elastic deformation as soon
17 as it is abutted against the lower side of the swing frame, and kept in
18 sliding contact with the latter over a predetermined width in the radial
19 direction to lessen the degree of its abrasive wear. Namely, when the

1 seal member is set in position, the lip portion is brought into a flexed
2 state against the lower side of the swing frame. As a result, even if the
3 vehicular base carrier and the upper swing structure of the machine
4 are moved in different directions to widen the spacing between the top
5 plateau wall of the grease bath and the swing frame under the
6 influence of vibrations which are generated during a machine
7 operation, such movements of the vehicular base carrier and upper
8 swing structure can be absorbed by elastic deformation of the lip
9 portion of the seal member, without allowing a gap space to be opened
10 up between the lip portion and the swing frame. Further, as the seal
11 member is set in position with the lip portion resiliently deformed in a
12 radially inward direction, seal member seals the grease bath more
13 tightly, pushing back pollutants or contaminants which tend to get
14 into the grease bath from between its lip portion and the swing frame

15 Furthermore, a lubricant like grease which gets between the seal
16 member and the swing frame can act to suppress abrasive wear of the
17 lip portion which is in sliding contact with the lower side of the swing
18 frame. For this purpose, a lubricant reservoir groove is formed on the
19 lipped end portion of the seal member radially on the outer side of the

1 lip portion to pool the same lubricant as the one in the grease bath. In
2 order to store a predetermined amount of lubricant in the lubricant
3 reservoir groove, it is desirable to form an annular reservoir groove on
4 the top side of the lipped end portion of the seal member or to form an
5 annular reservoir groove between the lip portion and an annular
6 projection which is formed at and around the outer periphery of the
7 lipped end portion radially at a space from the lip portion. In a case
8 where an annular projection is formed at the outer periphery of the
9 lipped end portion of the seal member, it may be arranged to stand
10 short of and out of contact with the lower side of the swing frame but it
11 is preferred to form the annular projection in a greater height to bring
12 an upper end portion of the annular projection into sliding contact
13 with the lower side of the swing frame for the purpose of preventing
14 overflowing of the lubricant. In this regard, the annular projection
15 may be extended in the same direction as the lip portion, but it is
16 preferred to make arrangements let upper end portions of the annular
17 projection undergo elastic deformation in the opposite direction
18 relative to elastic deformation of the lip portion.

19 The opening which is provided in the top plateau wall for

1 mounting a center joint is relatively narrow in diameter. Therefore, in
2 order to facilitate replacements of the seal member furthermore, the
3 top plateau wall of the grease bath may be constituted by two
4 separable parts, i.e., an outer plateau wall section which is formed
5 integrally with other bath-forming walls, and an inner plateau wall
6 section which is connected with the center joint. In a case where the
7 outer periphery of the inner plateau wall section is joined with the
8 inner periphery of the outer plateau wall section, it is desirable to
9 locate the seal member across joined ends of the inner and outer
10 plateau walls, sealing the joint portion with the main block body of the
11 seal member.

12 BRIEF DESCRIPTION OF THE DRAWINGS

13 In the accompanying drawings:

14 Fig. 1 is a schematic outer view of a hydraulic power shovel,
15 shown as a typical example of construction machines in general;

16 Fig. 2 is a schematic sectional view of a swing mechanism
17 incorporating a grease bath seal according to a first embodiment of the
18 present invention;

19 Fig. 3 is a fragmentary sectional view, showing the grease bath

1 seal of Fig. 2 on an enlarged scale;

2 Fig. 4 is a schematic view of a center joint in Fig. 2, taken from
3 the direction indicated by an arrow;

4 Fig. 5 is a schematic sectional view of a swing mechanism
5 incorporating a grease bath seal adopted as a second embodiment of
6 the present invention;

7 Fig. 6 is a fragmentary sectional view showing the grease bath
8 seal of Fig. 5 on an enlarged scale;

9 Fig. 7 is a fragmentary sectional view showing on an enlarged
10 scale the seal member of Fig. 5 which has been set in position by the
11 same method as in the first embodiment; and

12 Fig. 8 is a fragmentary sectional view showing another example
13 of separable plateau wall arrangement in the second embodiment of
14 the present invention.

15 BEST MODE FOR CARRYING OUT THE INVENTION

16 Hereafter, the present invention is described more particularly
17 by way of its preferred embodiments with reference to the
18 accompanying drawings. Referring first to Fig. 1, there is shown a
19 hydraulic power shovel or excavator as an example of construction

1 machine having a working mechanism including an excavation means
2 on an upper swing structure which is rotatably mounted on a vehicular
3 base carrier.

4 In the drawing, indicated at 1 is the vehicular base carrier with a
5 pair of crawler type drive means. An upper swing structure 2 is
6 rotatably mounted on top of the vehicular base carrier 1, and a front
7 working mechanism 3 with an earth excavating means is provided on
8 the upper swing structure 2. The upper swing structure 2 is
9 connected with the vehicular base carrier 1 through a swing
10 mechanism 4 to permit swing motions of the upper swing structure 2
11 relative to the vehicular base carrier 1.

12 Shown in Fig. 2 is the construction of the swing mechanism 4.
13 In that figure, indicated at 10 is a swing frame of the upper swing
14 structure 2, and at 11 a frame plate on the side of the vehicular base
15 carrier 1. An outer ring 12 is securely fixed to the swing frame 10 by
16 means of bolts 13, while an inner ring 14 is securely fixed to the top
17 frame plate 11 by means of bolts 15. These outer and inner rings 12
18 and 14 are relatively rotatably coupled with each other through swing
19 bearings 16.

1 In order to turn the swing frame 10, a swinging pinion 18 is
2 meshed with a ring gear 17 which is formed on and around the inner
3 periphery of the inner ring 14. The swinging pinion 18 is rotationally
4 driven from a swing drive motor 20 which is mounted on top of a base
5 19. A grease bath 21 is provided for the purpose of lubricating meshed
6 portions of the pinion 18 and the inner ring 14. This grease bath 21 is
7 securely fixed to the frame top plate 11 by welding or other suitable
8 fixation means, and arranged to define an annular bath of a
9 predetermined depth by way of bath-forming walls, i.e., a sunken
10 bottom wall 22 and an inner sloped or wall rising obliquely toward an
11 upper connecting portion 27 from the bottom wall 22. As a lubricant,
12 a suitable amount of grease is pooled in the grease bath 21. In the
13 case of the particular embodiment shown, the grease bath 21 is formed
14 in an annular shape and, in order to minimize the amount of grease to
15 be pooled, it is arranged to have a minimum necessary width which is
16 determined in relation with the outside diameter of the pinion 18.

17 A center joint 25 is placed in an opening 24 which is provided at
18 the center of rotation of the swing frame 10. The center joint 25 serves
19 to make connections of pipes which supply pressure oil to and from

1 the drive motor of the vehicular base carrier 1. Lower part 25B of the
2 center joint 25 is fixed on the vehicular base carrier 1 and relatively
3 rotatably coupled with an upper part 25A. Boot rubber 26 is fitted
4 around the upper part 25A of the center joint in such a way as to
5 shield the opening 24. This boot rubber 26 may be omitted in a case
6 where the opening 24 is completely sealed by means of a seal member
7 31 which will be described hereinlater. The lower part 25b of the
8 center joint 25 is connected to the inner end of a top plateau wall 27 of
9 the grease bath, which is extended horizontally inward from upper end
10 of the sloped or inclined wall 23.

11 Namely, in the enlarged view of Fig. 3, indicated at 30 is a seal
12 holder and at 31 a seal member 31. The seal holder 30 is in the form
13 of a staggered metal ring which is formed by bending an annular metal
14 strip at a radially halfway position into a staggered shape having a base
15 portion 30a, which is securely fixed on the upper side of the top
16 plateau wall 27, a riser wall portion 30b which rises in a radially
17 outward direction by a predetermined distance from the base portion
18 30a, and an annular holder wall portion 30c which extends radially
19 inward from the riser wall portion 30b substantially in parallel relation

1 with the top plateau wall 27. The seal holder 30 is arranged to
2 accommodate the seal member 31 between the annular gripping wall
3 portion 30c and the riser wall portion 30b. Namely, the seal member
4 31 is removably and fixedly gripped in position by the annular
5 gripping wall portion 30c and the riser wall portion 30b of the seal
6 holder member 30. On the other hand, the seal member 31 is formed
7 of resilient material like rubber, and provided with a main seal block
8 32 in the form of an annular block having substantially a rectangular
9 shape in section. More specifically, the main seal block 32 of the seal
10 member 31 is composed of an anchoring end portion 33 and a lipped
11 end portion which is formed integrally with the anchoring end portion
12 33 radially on the inner side of the latter. The lipped end portion 34 is
13 thicker than the anchoring end portion 33 and thus stepped up from
14 the latter. A lip 35 is extended radially outward from at the inner
15 periphery of the lipped end portion 34.

16 The seal member 31 which is retained in position by the seal
17 holder 30 functions to prevent dirt, soil or other contaminants from
18 entering the grease bath 21 through the opening 24 which is formed
19 in the swing frame 10 for mounting the center joint 25. Outer

1 peripheral edges of the fixed base end portion 30a of the seal holder
2 30 are located radially inward of the upper end of the inclined wall 23
3 which is connected to the top plateau wall 27. The diameter at the fore
4 distal end of the lip portion 35 of the seal member 31 is larger than
5 the diameter of the opening 24. Namely, the seal member 31 is
6 interposed between the central plateau wall portion 27 and the swing
7 frame 10 at a position which is as close as possible to the opening 24.

8 The annular gripping wall portion 30c of the seal holder member
9 30 is provided at a lower level than the top surface of the anchoring
10 end portion 33 of the seal member 31. Therefore, along with the
11 anchoring end portion 33, the main ring block 32 is retained
12 substantially in a compressed state and intimately pressed against the
13 top plateau wall 27 of the grease bath. Preferably, in a free state, the
14 main ring block 32 of the seal member 31 is arranged to have an
15 outside diameter slightly larger than an inside diameter at the outer
16 end of the riser wall portion 30b of the seal holder 30. As a
17 consequence, the seal member 31 is biased in radially outward
18 directions, and, once fitted in the seal holder 30, it is retained in
19 position in a stabilized state. In other words, the anchoring end

1 portion 33 of the seal member 30 is held in tight and intimate contact
2 with the upper side of the top plateau wall 27 and the seal holder 30 to
3 form a tight seal therebetween.

4 The lip portion 35 which is erected at the inner periphery of the
5 lipped end portion 34 may be extended straight in a radially outward
6 direction. However, it is more preferable to incline the lip portion 36
7 toward the center of rotation of the swing frame 10 as indicated by
8 imaginary line in Fig. 3. Further, in a free state, the height T1 of the
9 lip portion 35 on the top plateau wall 27 is larger than the width D of
10 the spacing between the top plateau wall 27 and the swing frame 10.
11 Accordingly, the lip portion 35 is held in contact with the lower side of
12 the swing frame 10 over a surface area of a predetermined width. The
13 width of the spacing between the swing frame 10 and the top plateau
14 wall 27 of the grease bath is varied by operational vibrations of the
15 construction machine. However, as long as such vibrations are smaller
16 than the dimensional difference between the height T1 of the seal
17 portion 35 and the width D of the spacing between the top plateau wall
18 27 and the swing frame 10, the seal member 31 functions to maintain
19 the tightness of its seal, that is to say, the lip portion 35 is held tightly

1 against the swing frame 10 and prevented from getting out of contact
2 with the swing frame 10. In a case where the lip portion 35 is inclined
3 in a radially inward direction as described above, it can be bent readily
4 in a radially inward direction as soon as it is abutted against the lower
5 side of the swing frame 10.

6 The lip portion 35 is erected at or in the close proximity of the
7 inner periphery of the lipped end portion 34 which has a
8 predetermined width in the radial direction between the lip portion 35
9 and the anchoring end portion 33. An annular groove 34a is formed
10 on the upper side of the lipped end portion 34 to serve as a reservoir of
11 a lubricant. In this instance, grease is pooled in the lubricant reservoir
12 groove 34a thereby to lubricate sliding surfaces on the lower side of
13 the swing frame 10 and on the lip portion 35.

14 Between the swing frame 10 and the top plateau wall 27, the
15 seal member 31 is not necessarily required to produce sealing effects
16 in those areas which are located radially inward of its own position.
17 However, if a large amount of contaminants enters the opening 24
18 from the side of the upper swing structure 2, it may impose adverse
19 effects on coupled portions of the upper and lower parts 25a and 25b

1 of the center joint 25. This is the reason why the boot rubber 26 is
2 fitted between the upper part 25a of the center joint 25 and the top
3 side of the swing frame 10. Nevertheless, the provision of the boot
4 rubber 26 is not a paramount requisite.

5 Further, if contaminants enter the opening 24 through the boot
6 rubber 26 and deposit on and around the lower part 25b of the center
7 joint 25, they may give rise to rust or deterioration of the seal member
8 31. For the purpose of precluding such troubles, the upper and lower
9 parts 25a and 25b of the center joint 25 are coupled with each other in
10 the manner as shown in Fig. 4. Namely, in order to pass the center
11 joint 25, the top plateau wall 27 is provided with a through hole 27a
12 which is larger than the outside diameter of the lower part 25b of the
13 center joint 25, and a plural number of radial connecting projections
14 36 (four radial connecting projections 36 in the case of the particular
15 embodiment shown) are provided at angular intervals around the lower
16 part 25b of the center joint 25. The radial projections 36 are
17 connected to the top plateau wall 27 by the use of bolts 38. Spacings
18 37 are provided between the top plateau wall 27 and the radial
19 projections 36, so that contaminants getting around the center joint

1 25 can be quickly and smoothly discharged through the spacings 37
2 instead of lingering on or around the center joint 25.

3 With the above-described construction, the grease bath 21 is
4 securely shielded off from the outside to prevent intrusion of water,
5 dirt, soil or other foreign material which would contaminate grease or
6 lubricant, accelerating abrasive wear of meshed portions of the ring
7 gear 17 and the revolving pinion 18 which are constantly supplied with
8 a lubricant from the grease bath 21.

9 More specifically, since the anchoring end portion 33 of the seal
10 member 31 is constantly pressed downward by the seal holder 30, the
11 seal member 31 is prevented from falling down even though the lip
12 portion 35 is abutted against the lower side of the swing frame 10 at a
13 position radially inward of the main seal block 32. Besides, since the
14 seal member 31 is held in a compressed state, it is tightly held in
15 contact with the top plateau wall 27 over the entire surfaces from the
16 main seal block 32 to the anchoring end portion 33. In addition, the
17 lip portion 35 is arranged to have a predetermined extra length so that
18 the extra length portion is pressed against and held in surface contact
19 with the lower side of the swing frame 10. Accordingly, there is no

1 possibility of the lip portion 35 being set apart from the swing frame 10
2 even if water and mud happen to act on the seal member 31 under
3 high pressure. That is to say, an extremely stable seal is formed by
4 the seal member 31.

5 When the upper swing structure 2 is turned, the lip portion 35
6 of the seal member 31 is caused to slide along the swing frame 10.
7 The seal member 31, particularly the lip portion 35 of the seal member
8 31 is located closely to the center of rotation of the swing frame 10.
9 Therefore, the radius of rotation of the lip portion 35, about the center
10 of rotation of the swing frame 10, is very small, so that its abrasive wear
11 can be suppressed to a minimum. In addition, abrasive wear is
12 suppressed furthermore by supply of grease to sliding portions of the
13 lip portion 35 and the swing frame 10 from the lubricant reservoir
14 groove 34a which is provided on the main seal block 34.

15 Since the lip portion 35 is pressed against the swing frame 10,
16 its sealing function will drop due to abrasive wear over a long period of
17 time. In such a case, it becomes necessary to replace the seal member
18 31. At the time of replacement of the seal member 31, the center joint
19 25 is disassembled and a new seal member 31 is placed in position

1 through the opening 24 of the swing frame 10. Since the seal member
2 31 is made of resilient material and only slightly larger than the
3 opening 24 in diameter, it can be easily deformed in a diametrical
4 direction into a smaller size suitable for passing through the swing
5 frame 10. The seal member 31 tends to restore its original size in
6 diameter as soon as it is placed in position on the top plateau wall 27.
7 Then, the seal member 31 is pushed to slide in a radially outward
8 direction along the top plateau wall 27 until the anchoring end portion
9 33 is accommodated to a predetermined extent in and by the seal
10 holder 30. Thus, the seal member 31 can be replaced in an extremely
11 facilitated manner.

12 Turning now to Figs. 5 and 6, there is shown a second
13 embodiment of the present invention. In the case of this second
14 embodiment, a main seal block 132 of a seal member 131 is composed
15 of an anchoring end portion 133 and a lipped end portion 134. A lip
16 portion 135 is erected at the inner periphery of the lipped end portion
17 134. This lip portion 135 is inclined in a radially inward direction by a
18 predetermined inclination angle. In these respects, the seal member
19 131 has no differences from the counterpart in the foregoing first

1 embodiment. In the present embodiment, the seal member 131 is
2 provided with an annular projection 136 on its outer peripheral side,
3 in such a way as to define an annular lubricant reservoir groove 137
4 between the lip portion 136 and the annular projection 136 for storing
5 therein a lubricant like grease.

6 In this instance, the annular projection 136 is not necessarily
7 required to have such a height which is sufficient for abutting
8 engagement with the lower side of the swing frame 10. However, in
9 order to prevent grease from flowing out of the annular storage groove
10 137, it is preferred that the upper end of annular projection 136 be
11 kept in abutting engagement with the lower side of the swing frame 10
12 as shown in Fig. 6. More preferably, the seal member 131 is arranged
13 such the annular projection 136 has a height H_2 from the bottom side
14 of the seal member 131, which is larger than the width D of the
15 spacing between the top plateau wall 127 and the swing frame 10, and
16 the annular projection 136 is inclined in a direction away from the lip
17 portion 135 or inclined to the outer peripheral side by a
18 predetermined inclination angle. When arranged in such a way, there
19 is no possibility of a gap space opening up on the lower side of the

1 swing frame 10 and the upper end of the annular projection 136 as a
2 result of abrasive wear caused by swing motions of the upper swing
3 structure 2. However, the height T2 of the annular projection 136 may
4 be shorter than the height 1 of the lip portion 135.

5 In the same manner as in the foregoing first embodiment, the
6 seal member 131 can be assembled with the seal holder 130 on the
7 top plateau wall 127. More specifically, upon fitting the anchoring end
8 portion 133 of the seal member 131 into the seal holder 130 on the
9 top plateau wall 127 from inner side, the annular projection 136 is
10 flexed in the same direction as the lip portion 135 as shown in Fig. 7.
11 As a result, the grease reservoir groove 137 is deformed to some extent,
12 but the deformation would not give rise to any problem in particular as
13 long as a grease reservoir space exists within the groove 137.

14 However, in case it is desired to store a greater amount of grease
15 in the annular storage groove 137, the upper end of the annular
16 projection 136 may be flexibly bent in a radially outward direction
17 away from the lip portion 135 as shown in Fig. 6. Further, in order to
18 facilitate mounting of the seal member 131 itself, it is desirable to
19 make arrangements as follows. Namely, to permit facilitated mounting

1 of the seal member 131, the top plateau wall 127 is composed of two
2 separably connected parts as shown in Fig. 5, i.e., an outer plateau
3 wall section 127a which is provided integrally with the bottom and
4 sloped walls of the grease bath in the foregoing first embodiment, and
5 an inner plateau wall section 127b which is connected to the center
6 joint 25. In this case, the seal holder 130 is provided on the part of the
7 inner plateau section 127b.

8 The outer and inner plateau wall sections 127a and 127b are
9 connected to each other by means of bolts 140 at a position radially on
10 the outer side of the seal holder 130, with connecting end portions of
11 the outer and inner plateau wall sections 127a and 127b overlapped
12 one on the other over a predetermined length. In this instance, nuts
13 141 are fixedly provided on the top side of the outer plateau wall
14 section 127a by welding or other fixation means. Besides, although
15 not shown in the drawings, a seal member is interposed between
16 overlapped end portions of the outer and inner plateau wall sections
17 127a and 127b.

18 With the arrangements just described, after removing the inner
19 plateau wall section 127b along with the center joint 25, the seal

1 member 131 is set in the seal holder 130 which is fixed on the inner
2 plateau wall section 127b, and grease is filled in the lubricant reservoir
3 groove 137. Then, an outer end portion of the inner plateau wall
4 section 127b is abutted against the outer plateau wall section 127a
5 from beneath and connected to the latter by tightening the bolts 140
6 into the nuts 141. Whereupon, the lip portion 135 and the annular
7 projection 136 of the seal member 131 are caused to flex in radially
8 inward and outward directions, respectively, permitting to store a
9 larger amount of grease therebetween. In this case, since the seal
10 member 131 can be set in position on the inner plateau wall section
11 127b which is in a totally exposed state, it can be quite easily set in
12 the seal holder 130 because the seal member 131 is subjected to
13 compressive deformation in a less degree.

14 Further, shown in Fig. 8 is another modification in which a seal
15 holder 230 is mounted on an outer plateau wall section 227a which is
16 arranged to integrally include the respective bath-forming walls of the
17 grease bath 21, and joined at its inner periphery end with an inner
18 plateau wall section 227b which is connected to the center joint 25. In
19 this case, for facilitating mounting of the seal member 231 and at the

1 same time for sealing joined end portions with the seal member 231,
2 the outer and inner plateau wall sections 227a and 227b are arranged
3 to be joined at a position beneath the seal member 231. An annular
4 extension 250 is fixedly welded or bolted to outer peripheral portions
5 of the inner plateau wall section 227b and abutted against inner
6 peripheral portions of the outer plateau wall section 227b from
7 beneath thereby to support the loads of the outer plateau wall section
8 227a.

9 POSSIBILITIES OF INDUSTRIAL UTILIZATION

10 Being arranged in the manner as described above, the grease
11 bath seal according to the present invention can prevent foreign matter
12 such as water and mud from getting into a grease bath, preventing
13 deterioration of a lubricant like grease and prolonging its service life in
14 a very reliable manner.

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